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### APPLICATION OF ELECTRONIC DATA PROCESSING TO REAL ESTATE APPRAISALS

**I**N May 1955 a research program on the application of electronic data processing to the appraisal field was instituted. The results of this research are covered in this report.

The first step in the research program was a statistical analysis of all the appraisals made by Roy Wenzlick & Co. The analysis covered individual and mass appraisals for a 27-year period. The study readily showed that appraisal computations were adaptable for electronic data processing. The computational pattern was routine and was the portion of every appraisal most subject to error. Electronic data processing could not automate the field work, nor could it replace the appraiser's final judgment as to the value of a property.

A statistical summary of all appraisal computations pointed out the requirements for converting to electronic data processing. These requirements can be catalogued as follows: 1. special design cost manual; 2. simplified appraisal record form; 3. tabulating card format to accommodate data from both the cost manual and the appraisal record card; 4. an electronic computer program to coordinate the flow of data from the appraisal form to the tabulating card, then the automatic costing of the tabulating card from the manual, and finally the calculating of the tabulating card data on the computer to produce the value.

Insofar as our research followed the above stages of investigation, this report will maintain that order.

Appraisal Cost Manual. The statistical summary pointed out the need for a new type of cost manual. The new manual had to meet the following specifications:

1. It must be capable of being encoded.
2. Base cost factors must cover a wide array of building types, quality of construction, and building materials.
3. Additions to and deductions from base cost factors must be kept to a minimum.
4. Although the manual is designed for electronic data processing, it must have simplicity to allow for hand computing.

It is understood that reproduction costs derived from the manual must be accurate.

In October 1955, preparation began on an appraisal manual to be used for the Washington, D. C., reassessment program. In developing and designing this manual we incorporated and maintained the aforementioned specifications. After rigid field testing the manual was published in November 1956. Although this manual was not used for electronic data processing, it proved to be excellent for hand computing.

In September 1957, an appraisal manual for the St. Louis County reassessment program was developed following the Washington format. The St. Louis County manual was used in the electronic data processing of 185,000 appraisals. Our Residential Appraisal Manual, used by over 3,000 organizations for making appraisals, is the direct result of this research.

**Appraisal Record Form.** The appraisal file analysis indicated that the electronic data processing of appraisals would require a specially designed appraisal record form. In designing the form, it would be necessary to incorporate the following:

1. primary form adaptable to all types of property; 2. building characteristics arranged in systematic order; 3. computing section of form arranged for coding and sequenced for keypunching; 4. all computed values easily readable by the appraiser.

The design of the form employed a check-off and numbering system. The front of the form was divided into sections; each section, describing a component of the building, was numbered, with each characteristic of the component listed with a box to check for its presence. A portion of the form is shown on the left. The other side of the form provided a grid section for building layout, and sections for accessory building, miscellaneous features, and computations. The computing section was designed for coding, and sequenced in a standard order. Additions to and deductions from base cost were referenced numerically

1. USE OR OCCUPANCY		4. ROOF STRUCTURE	
Residential	Comm'l. - indus.		
<input checked="" type="checkbox"/> 1 fam dwell	Apt bldg	<input checked="" type="checkbox"/> Flat	
<input type="checkbox"/> 2 fam dwell	Stores/apts	<input type="checkbox"/> Gable	
<input type="checkbox"/> Row house	Stores/office	<input type="checkbox"/> Hip	
<input type="checkbox"/> 2-4 fam flat	Store only	<input type="checkbox"/> Gambrel	
<input type="checkbox"/> Walkup apt	Off. bldg.	<input type="checkbox"/> Mansard	
<input type="checkbox"/> Farm	Hotel	<input type="checkbox"/> Mixed	
<input type="checkbox"/> Other	Bank	<input type="checkbox"/> Other	
<input type="checkbox"/> Exempt	Theater	<input type="checkbox"/> Dormers	
<input type="checkbox"/> Church	Pub. gar.	5. ROOF COVER	
<input type="checkbox"/> School	Fill. sta.	<input type="checkbox"/> Asphalt shingle	
<input type="checkbox"/> Pub. hosp.	Warehouse	<input checked="" type="checkbox"/> Asbestos shingle	
<input type="checkbox"/> Govt. bldg.	Indus. bldg.	<input type="checkbox"/> Wood shingle	
<input type="checkbox"/> Other	Other	<input type="checkbox"/> Metal	
		<input type="checkbox"/> Slate	
		<input type="checkbox"/> Tile	
2. EXTERIOR WALLS		<input type="checkbox"/> Tar & gravel (composition)	
<input type="checkbox"/> Frame siding		<input type="checkbox"/> Roll	
<input type="checkbox"/> Metal siding		<input type="checkbox"/> Other	
<input type="checkbox"/> Wood shingle		6. GUTTERS & DOWNSPOUTS	
<input type="checkbox"/> Asbestos shingle		<input type="checkbox"/> Galvanized	
<input type="checkbox"/> Stucco on frame		<input checked="" type="checkbox"/> Copper	
<input type="checkbox"/> Stucco on masonry		<input type="checkbox"/> Aluminum	
<input type="checkbox"/> Brick, 8"		<input type="checkbox"/> None	
<input checked="" type="checkbox"/> Brick, 12"		7. WINDOWS	
<input type="checkbox"/> Brick veneer		<input checked="" type="checkbox"/> Double hung	
<input type="checkbox"/> Stone, rough		<input type="checkbox"/> Casement	
<input type="checkbox"/> Stone, cut		<input type="checkbox"/> Awning type	
<input type="checkbox"/> Concrete block		<input checked="" type="checkbox"/> Picture	
<input type="checkbox"/> Composition siding		<input checked="" type="checkbox"/> Frame	
<input type="checkbox"/> Other		<input checked="" type="checkbox"/> Metal	
3. FOUNDATION			
<input checked="" type="checkbox"/> Poured conc.	<input type="checkbox"/> 8" <input checked="" type="checkbox"/> 12"	Weatherstrip	<input checked="" type="checkbox"/>
<input type="checkbox"/> Concrete block		Screens	<input checked="" type="checkbox"/>
<input type="checkbox"/> Stone		Storm sash	<input checked="" type="checkbox"/>
<input type="checkbox"/> Posts or piers		Combination	<input checked="" type="checkbox"/>
<input type="checkbox"/> Other			

according to component sections. The data in the computing section can be punched into tabulating cards. The computed values when entered on the form are readily visible to the appraiser. Field testing of this form revealed another advantage. The check-off system increased the efficiency and speed in collecting property data.

**Tabulating Card Format.** The statistical analysis of the appraisal files uncovered some very interesting facts on construction. Over 50% of the buildings appraised had two or more sections of varying story heights. In 35% of the occurrences each section had exterior walls of different material. Building layouts had a wide variance in shape; in order to determine the total square foot area, as many as eight extensions (width x depth) had to be computed. Approximately 65% of the buildings required three or more extensions. Most residential buildings had one porch, about 45% had two or three porches. Garages were present on 80% of the appraisals. In addition to the garages, about 20% of the properties had sheds, quonset huts, small greenhouses, and other type accessory buildings.

The data coverages required in the tabulating card format presented a difficult problem. Basically, there are two tabulating card systems - one system employing an 80-column card, and the other using a 90-column card. The appraisal file statistics readily indicated that there was an excessive amount of data for one card of either system. By statistical experimenting we concluded that a minimum of three tabulating cards were required. The 90-column card system was adopted because it afforded a 30-column advantage over the other system. The format design followed the sequence of data and calculations made in every appraisal. One format was employed, but a number designated the information that each of the three cards contains. All three cards contain an identification; data are entered on two lines. The data content of each card is as follows:

**Card 1.** Basic data on type structure, quality, building material, story height, basement specifications, and dimensions. Processing of this card, described under "Computer Program," will produce: areas and base costs by sections, basement additions or deductions, and replacement cost of base structure.

**Card 2.** Basic data on numeric reference to additions and deductions, and porch specifications with areas. Processing will summarize the additions to and deductions from base cost, cost all porches, and compute their value.

**Card 3.** Basic data on accessory building specifications with areas, depreciation factors, and land descriptions with unit value. Processing will cost the accessory buildings and compute their value, summarize the entire appraisal for total replacement value,

adjust for depreciation to give market value of improvement, compute land value, and compute total market price of the property.

Computer Program. In selecting the 90-column tabulating card, the program employed the Univac computer. Each step in the program followed the computational sequence in an appraisal. The introduction of cost manual data into each step presented the real problem. By the use of a code system, the manual data and the field record card data could be coordinated. The cost manual was encoded and punched into a master deck of tabulating cards. The purpose of the master deck is the costing of each appraisal. The computer available for our research did not have sufficient data storage to accommodate approximately 15,000 cards in the master deck. To transfer the data from master card to appraisal punch cards we employed a Collating Reproducer. A computer with magnetic tape or file drum storage, however, would have simplified this operation. A preliminary program was then outlined using all available equipment.

On December 14, 1955, the program was tested on the Washington, D. C., reassessment program. The test results were very encouraging. For the first time complete electronic data processing of real estate appraisal computations was possible. This field test indicated steps of refinement in our program. Further research developed a new improved program that introduced checking steps.

The St. Louis County reassessment project provided the first test for our new computer program. In November 1957 we computed 5,500 appraisals on a Univac 120. The program proved to be very satisfactory and by the time the project was completed we had electronically data-processed over 185,000 appraisals. The appraisals were computed in 5,000 to 6,000 parcel groups. The program steps were as follows:

Step 1. All card 1's were sent through the computer to calculate the area of each parcel.

Step 2. Card 1's were then sorted by type structure, building material, story height, and area.

Step 3. Card 1's were collated with the master deck of the manual and costed on a Collating Reproducer.

Step 4. Card 1's were sent through the computer to calculate the base replacement cost of the main structure.

Step 5. Card 2's were sorted on porch specifications and interspersed gang-punched with porch costs from the master deck.

Step 6. Card 3's were sorted on accessory building specifications and interspersed gang-punched with accessory building costs from the master deck.

Step 7. The three cards on each appraisal were collated and put in 1-2-3 sequence.

Step 8. The cards were put in sequence through the computer to calculate the value of each appraisal by the cost approach.

Step 9. The cards were sent through an interpreter to print the answers that had been punched on each card. The answer from the punch cards was then entered on the field record cards to be reviewed by the appraiser.

Conclusions. The computing of 185,000 appraisals proved that electronic data processing was applicable to the real estate appraisal field. Mass appraising using electronic data processing had many advantages, such as:

1. Computation attained a degree of accuracy that heretofore was unobtainable due to prohibitive cost.
2. Complete uniform costing of all appraisals was possible for the first time.
3. Periodic revaluation of all appraisals can be made simply by duplicating the original tabulating cards and processing them with cost data from a current master deck.
4. The tabulating cards can be used to produce numerous documents and accumulate statistical data.
5. Production increased from 20 computed appraisals to 85 computed appraisals per day per employee.
6. Appraisal computation costs were substantially reduced.

Although the most likely prospective employment of this program would be in the field of real estate assessment, there are several interesting possibilities.

Savings and investment institutions having vast mortgage portfolios could conceivably evaluate their holdings annually. Annual valuation of each mortgaged property in a large portfolio would readily point out mortgages that have questionable risk. Ratio studies between property value and mortgage loan

outstanding on each property might be very significant if we entered into a rapidly declining market.

Application of electronic data processing to individual appraisals would seem to be remote at the present. It is conceivable that a real estate board or appraisal chapter would institute a computing bureau to calculate appraisals from uniform cost. As part of this service, a permanent comparable sales data system would be installed. The appraiser subscribing to the service would receive with each computed appraisal a listing of comparable sales. Many hours of research could be saved by the appraiser using this system.

Many developments are constantly taking place in electronic data processing. For example, during the past month one major company introduced an optical scanning punch which, when used with our program, positively classes the quality of construction on any property by checking building characteristics. With each piece of new equipment we improve our processes and methods. The time may come when the equipment and facilities are within cost range of every appraiser.

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